PROJECT facts

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

High Efficiency Engines and Turbines

12/2002

ADVANCED THERMAL BARRIER COATINGS FOR INDUSTRIAL GAS TURBINE ENGINES

Description

PRIMARY PARTNER

University of Connecticut

TOTAL ESTIMATED COST

$ 285,085

CUSTOMER SERVICE

800-553-7681

WEBSITE

www.netl.doe.gov

Under the Advanced Gas Turbine Systems Research (AGTSR) program, the University of Connecticut (UCONN) is working with thermal barrier coating (TBC) suppliers and US turbine manufacturers to develop highly advanced TBC's. Task 1 surveys the materials data base to identify up to six promising ceramics for advanced TBC's. Task 2 prepares powders and hot-pressed compacts of the candidate ceramics for thermal conductivity measurements and hot corrosion tests. The three most promising ceramics are then identified based on these tests. Task 3 applies the three most promising ceramics over bond coats on specimens for thermal cycle tests in the presence of corrodents to demonstrate and validate their superior durability compared to the conventional yttria-stabilized zirconia (YSZ) TBC.

To date, using screening criteria that considered eight physical, mechanical and chemical properties, the project has identified three promising materials. The thermal conductivities of these ceramics were found to be significantly lower than for a conventional YSZ. Figure 1 shows data indicating the lower thermal conductivity of one of these ceramics. For TBC applications, the promising new top coat ceramics would be in contact with an Al2O3 thermally grown oxide (TGO). On-going work is evaluating the compatibility of the three promising ceramics with TGO and electron beam physical deposition of the new coatings.

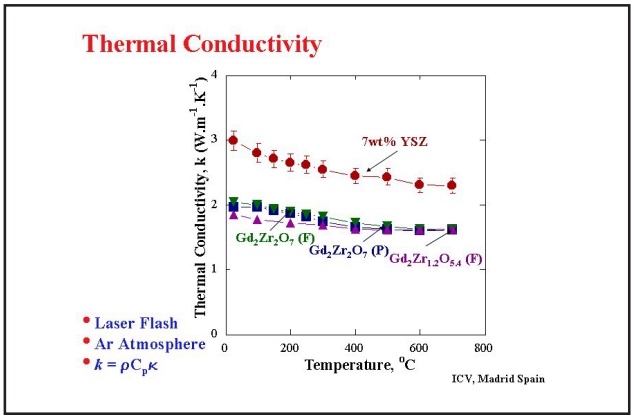

Figure 1. Gr-Z oxides with lower thermal conductivity than YSZ.

Advanced Thermal Barrier Coatings for Industrial Gas Turbine Engines

CONTACT POINTS

Tom George
National Energy Technology Laboratory
P.O. Box 880
3610 Collins Ferry Rd.
Morgantown, WV 26507-0880
304-285-4825
tgeorg@netl.doe.gov

Richard Dennis
Product Manager,
High Efficiency Engines and Turbines
National Energy Technology Laboratory
P.O. Box 880
3610 Collins Ferry Rd.
Morgantown, WV 26507-0880
304-285-4515
richard.dennis@netl.doe.gov

Richard Wenglarz
South Carolina Institute for Energy Studies
386-2 College Ave.
Clemson, SC 29634
864-656-2267
rwnglrz@clemson.edu

Professor Nitin Padture
University of Connecticut
Department of Metallurgy and Mechanical Engineering
97 North Eagleville Road
Storrs, CT 06269
860-486-4620
nitin.padture@uconn.edu

Duration

24 months

Goals

The goals of the project are to identify and validate an advanced TBC with 5 times the hot corrosion resistance, 50 % of the thermal conductivity, and a 175 C (300 F) increase in the maximum temperature capability compared the current state of the art YSZ-based TBC.

Benefits

Success in achieving the project goals for an advanced TBC that could raise turbine inlet temperatures by 175 C (300 F) has the potential of:

- $ 4.7 Billion fuel cost savings over a ten-year time frame (for $3.00/ MMBtu gas)
- 156 million metric tons in reduced CO_2 emissions
- Achievement of a major portion of the near-term efficiency improvement and CO_2 emission reduction goals of the DOE gas turbine program